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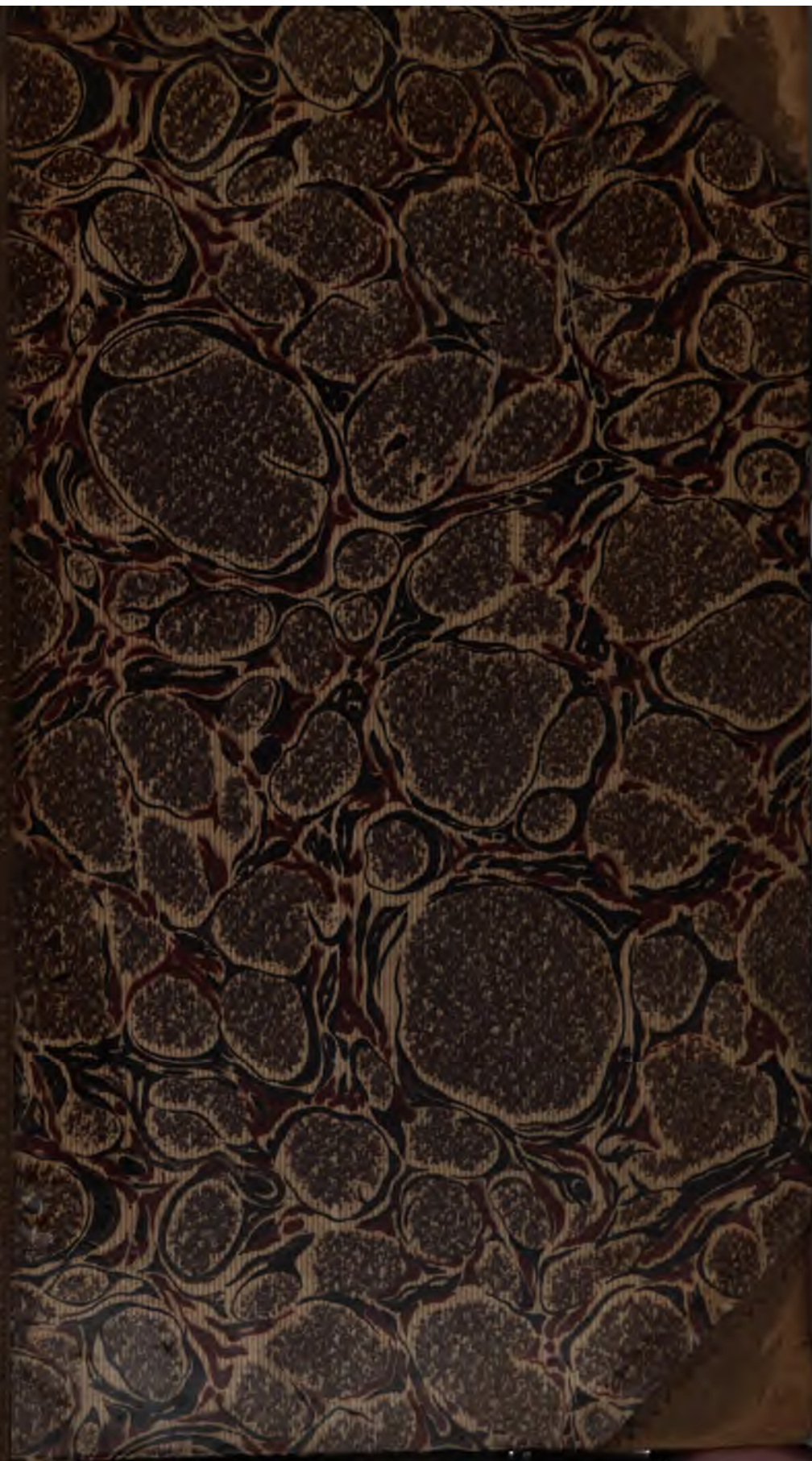
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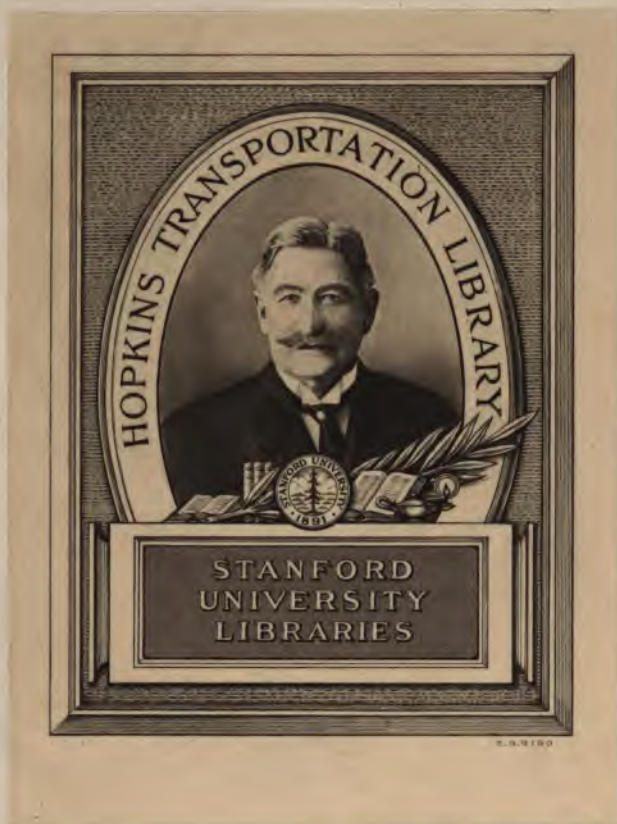
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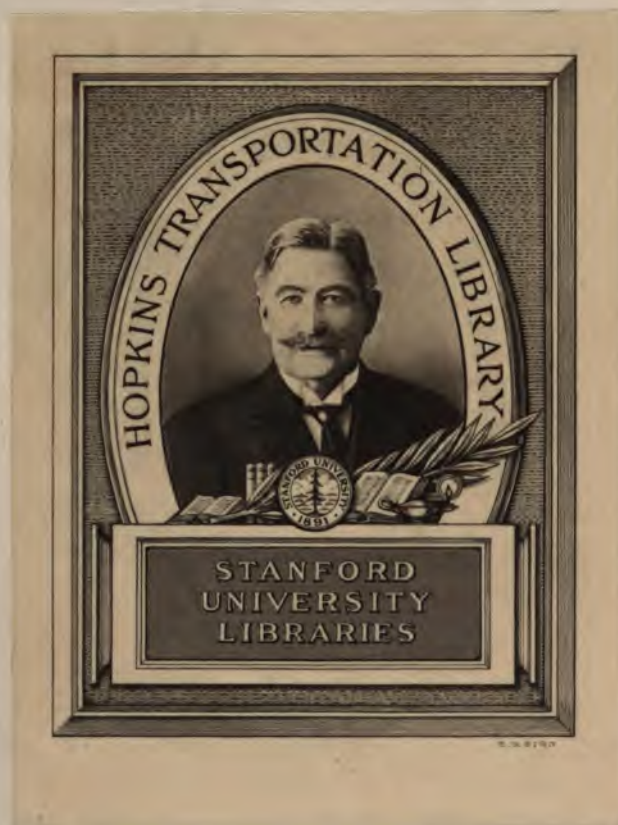
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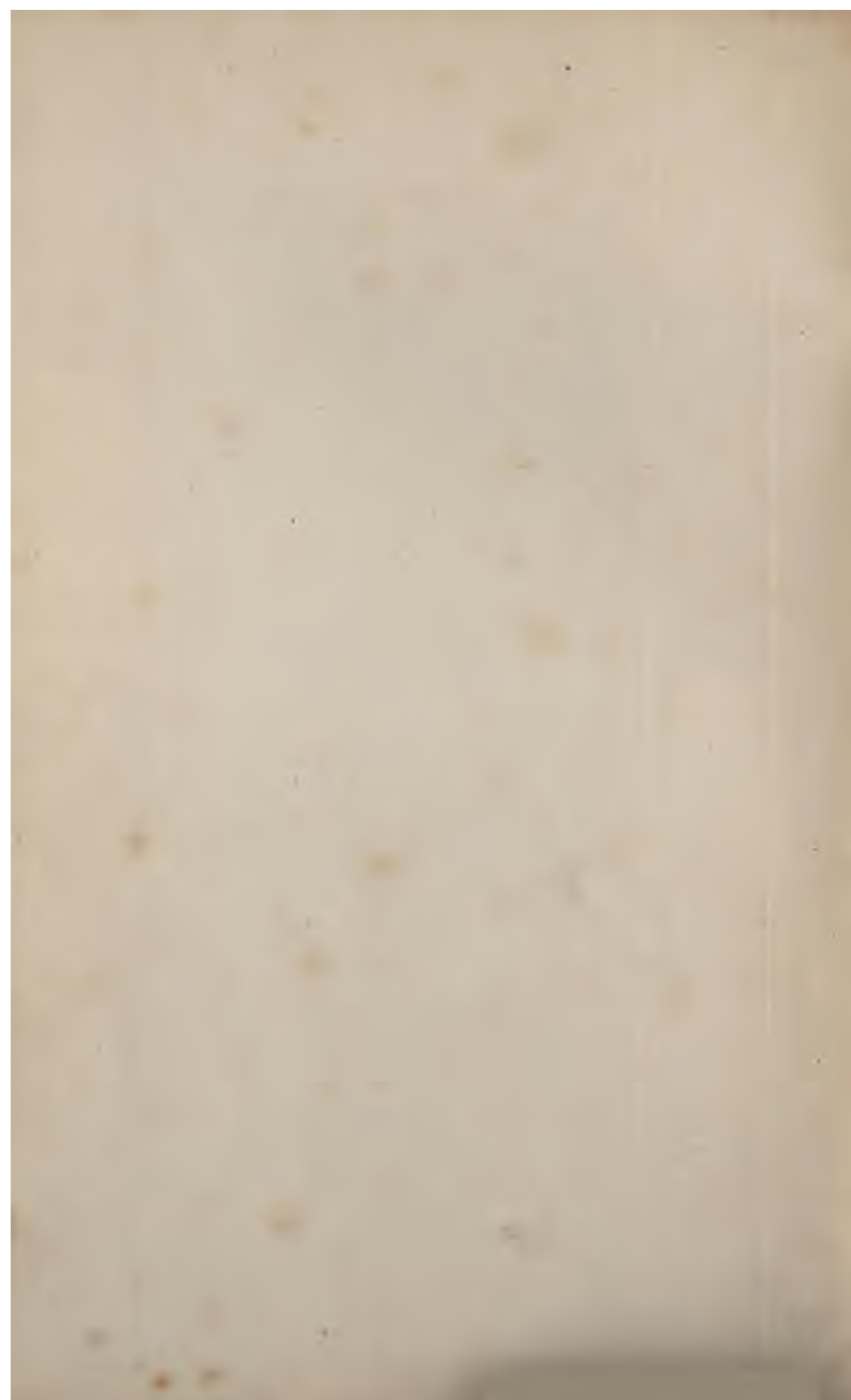
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ATMOSPHERIC RAILWAY.

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CLEGG AND SAMUDA'S

ATMOSPHERIC RAILWAY.

THE commercial wealth and importance of every Empire, and its rise in the scale of civilization, has from the earliest ages been consequent upon its availing itself of every facility of communication with the cities and states by which it was surrounded ; and in proportion as communication was cultivated, the commercial exchange of commodities developed resources before unknown, and opened new opportunities of profitable employment for thousands.

England has established her superiority among nations by the enterprize of her inhabitants,—by their energies her relation with foreign possessions has been improved, her internal resources unfolded, and communication with foreign powers facilitated ; her vessels are to be found trading in every port in the world, her manufactures are carried back in large quantities to the very countries where the raw material was produced,—and the result has been that her

wealth and population has increased beyond precedent. But though her facilities of communication, both internal and external, are not equalled by any other nation, her proud pre-eminence can only be preserved by the same means which attained it, the encouragement of invention and improvement.

Among the most recent and greatest of her improvements are Railways; their introduction has given a new stimulus to the industry of her inhabitants, and presented increased facilities for the merchant, manufacturer, and agriculturist, by bringing the remotest parts of the kingdom within a day's journey, thus enabling goods and agricultural produce to be conveyed to distant towns, for which the previous mode of transport was unequal; indeed the numerous advantages of Railways have been fully appreciated by the public, who have not hesitated to embark immense sums of money to construct them between most of the principal towns.

In proportion as persons have acquired a knowledge of the commercial benefits that arise from this improved system of travelling, and have felt practically the advantages of it, their distaste for the old mode of conveyance has increased, and if Railway communication was attainable, at a cost at all approximating to that previously employed, it would very shortly become universal throughout the empire. But the general adoption of the Railway system followed its introduction so speedily, that many roads were half finished before their expences could be ascertained; each town capable of raising sufficient capital to connect itself with the Metropolis, did so immediately,—more eager to

be on a par with its neighbour, than considerate of the expence it was about to incur. Fortunately these increased facilities *created* in many cases a traffic which compensated for the unexpected outlay that was found necessary to form and work these roads ; and as there is now so large a portion of capital sunk in this description of property, and a moral certainty that a greater number of Railways will be made in the next ten years than have been made and partially completed in the last*, any invention tending to facilitate their formation, or to reduce their cost, is a matter of the greatest national and commercial importance : and if by such an invention the speed of travelling can be further increased, the danger of accidents diminished, and the expence of transporting goods reduced to as low a rate as by canals, the traffic, and (as a natural consequence,) the remuneration to the proprietors, will be proportionably augmented.

The principal defects in Railways worked by locomotive power, are the expences consequent upon their formation and working, in addition to the impossibility of obtaining a speed beyond twenty-five miles an hour, without incurring a more than proportionate additional expence. For an engine that would draw 61·29 tons on a level at the rate of twenty-five miles an hour, would, if required to travel thirty miles an hour, only be able to draw 29·66 tons, or, for the additional five miles in speed, a loss of more than one-half in power. These evils arise from the following causes :—

* In England alone, since 1831, upwards of 2000 miles of Railway have been completed, or are in progress of completion.

First, from the necessity of making the roads comparatively level, caused by the nature of the power employed. The whole power of the Locomotive Engine is not available to impel the *train*, because it has to drag itself and tender. Thus a great portion of its power is consumed even on a level; but that loss of power is greatly augmented when contending with the slightest ascent.

The extent of this defect will be more clearly apparent by an example:—

Supposing a Locomotive Engine to possess a gross tractive force of 1,700 pounds, and its weight, including tender, to be 20 tons, (this is the actual weight and tractive force of the best Locomotive Engines in general use when travelling at a mean rate of twenty miles per hour,) and as 14lbs. per ton is required to attain this velocity on a level road, 280lbs. will be consumed to impel the engine and tender, leaving 1,420lbs. available for the train. This at 14lbs. per ton will draw 101 tons on a level road. We will now place the same train on an inclined plane rising 1 in 50. The power required to draw a ton at the same speed is then increased from 14lbs. to 59lbs., or nearly $4\frac{1}{4}$ times as much as on a level: therefore the engine and tender weighing 20 tons will consume 1,180lbs. instead of 280, and will leave but 520lbs. available for the train, instead of 1,420lbs.; but as the train now needs 5,959lbs. to enable it to ascend, $11\frac{1}{2}$ locomotives, each possessing a tractive force of 1,700lbs., together 19,550lbs., will be required to produce that available force; we thus see an absolute waste of more than $\frac{2}{3}$ of the power employed on an ascent of 1 in 50, while on a level this waste is less than $\frac{1}{6}$ th. By

the same calculation it will be seen, that if the acclivity be slightly increased, the Locomotive Engine will not have sufficient power to draw itself and tender, even without the train.

Secondly, by the necessity of having great weight and strength of rails and foundation consequent on the employment of Locomotive Engines. These engines (exclusive of tender), weigh generally from fourteen to fifteen tons each, and in addition to the rigidity of road required to sustain this weight passing over it on one carriage, the motion transferred to the wheels by the engines alternately on each side, causes a continual displacement or forcing out of the rails.

The third, and perhaps greatest evil, is the heavy expense attendant on working a Railway by the ordinary method, and this item is rendered more excessive by the necessity of having a large number of extra engines in store to keep an adequate supply in working order. By reference to the half-yearly accounts of the Liverpool and Manchester Railway, the annual expense for Locomotive power and coke is found to be from £57,000 to £60,000 a-year, nearly £2,000 a mile per annum, on a traffic of about 1,700 tons a-day. This amount is exclusive of first cost and interest on the original stock.

The fourth evil, is the large consumption of fuel in proportion to the power obtained, which arises, in part, from the great velocity in the movement of the pistons, which prevents the steam from acting on them with full effect; but principally from the necessity of contracting the waste steam pipe, so as to obtain sufficient draft for the

fire. This causes a back pressure on the pistons, and reduces their force in proportion to the velocity at which they move. Thus the power of the engine is constantly diminishing as the velocity of the train is increasing. To so great an extent is the combined action of these defects felt, that when travelling at twenty miles per hour, the effective power of the engine is reduced to half that which would be obtained from the same quantity of steam generated, and fuel consumed, with a stationary engine.—When travelling at thirty miles per hour it is reduced to less than one-fourth; and at a speed but little exceeding forty-five miles, the power is so far destroyed that the engine will draw scarcely more than itself and tender. An additional waste of fuel, to an immense extent, is also occasioned by the loss of power already shown on inclined planes.

From the foregoing remarks it will appear that the evils of the present system are entirely attributable to the use of Locomotive power, and the remedy must be sought for in the employment of stationary power in its stead: the means by which this can be effected without diminishing the accommodation and advantages at present given to the public, is next to be considered; and it is confidently expected that in the following description will be found, not only remedies for all existing evils, but also many important advantages, both in speed and safety, which cannot possibly be obtained at present.

IN Clegg and Samuda's Atmospheric Railway, the power employed is the pressure of the Atmosphere, brought into action by exhaustion. By reference to the plates at the commencement the following description will be rendered more clear :—

Fig. 1.—Is a general elevation of the Railway, with a train of carriages passing over it.

Fig. 2.—Is a plan of the Railway, with the upper surface of the pipe, at the part containing the entrance separating valve, removed, to show its construction.

Fig. 3.—Is a longitudinal section of the Railway, taken at the dotted line *mm* fig. 4, showing the connection between the piston and the train carriage and the method of lifting the continuous valve.

Fig. 4.—Is a transverse section of the same.

Fig. 5.—Is a transverse section of the pipe on an enlarged scale, showing the continuous valve and cover, and also the heater *N*, in dotted lines.

Fig. 6.—A plan of the continuous valve on an enlarged scale.

The moving power is communicated to the train through a continuous pipe or main, *A*, laid between the rails, which is exhausted by air pumps worked by stationary steam engines, fixed on the road side, the distance

between them varying from one to three miles, according to the nature and traffic of the road. A piston, *b*, which is introduced into this pipe, is attached to the leading carriage in each train, through a lateral opening, and is made to travel forward by means of the exhaustion created in front of it. The continuous pipe is fixed between the rails and bolted to the sleepers which carry them; the inside of the tube is unbored, but lined or coated with tallow $\frac{1}{10}$ th of an inch thick, to equalize the surface and prevent any unnecessary friction from the passage of the travelling piston through it. Along the upper surface of the pipe is a continuous slit or groove about two inches wide. This groove is covered by a valve, *c*, extending the whole length of the railway, formed of a strip of leather rivetted between iron plates, as shown at figs. 5 and 6, the top plates being wider than the groove and serving to prevent the external air forcing the leather into the pipe when the vacuum is formed within it; and the lower plates fitting into the groove when the valve is shut, makes up the circle of the pipe, and prevents the air from passing the piston; one edge of this valve is securely held down by iron bars, No. 2 (fig. 5), fastened by screw bolts, No. 4, to a longitudinal rib cast on the pipe, and allows the leather between the plates and the bar to act as a hinge, similar to a common pump valve; the other edge of the valve falls into a groove which contains a composition of beeswax and tallow: this composition is solid at the temperature of the atmosphere, and becomes fluid when heated a few degrees above it. Over this valve is a protecting cover, *1*, which serves

to preserve it from snow or rain, formed of thin plates of iron about five feet long hinged with leather, and the end of each plate underlaps the next in the direction of the piston's motion, thus ensuring the lifting of each in succession. To the underside of the first carriage in each train is attached the piston, *в*, and its appurtenances; a rod passing horizontally from the piston is attached to a connecting arm, *с*, about six feet behind the piston. This connecting arm passes through the continuous groove in the pipe, and being fixed to the carriage, imparts motion to the train as the tube becomes exhausted; to the piston rod are also attached four steel wheels, *нн*, (two in advance and two behind the connecting arm,) which serve to lift the valve, and form a space for the passage of the connecting arm, and also for the admission of air to the back of the piston; another steel wheel is attached to the carriage, regulated by a spring, which serves to ensure the perfect closing of the valve, by running over the top plates immediately after the arm has passed. A copper tube or heater, *н*, about ten feet long, constantly kept hot by a small stove, *з*, also fixed to the under side of the carriage, passes over and melts the surface of the composition (which has been broken by lifting the valve,) which upon cooling becomes solid, and hermetically seals the valve. Thus each train in passing leaves the pipe in a fit state to receive the next train.

The continuous pipe is divided into suitable sections (according to the respective distance of the fixed steam engines) by separating valves, *ф* and *q*, which are opened by

the train as it goes along: these valves are so constructed that no stoppage or diminution of speed is necessary in passing from one section to another. The exit separating valve, *q*, or that at the end of the section nearest to its steam engine, is opened by the compression of air in front of the piston, which necessarily takes place after it has passed the branch which communicates with the air-pump; the entrance separating valve *f*, (that near the commencement of the next section of pipe,) is an equilibrium or balance valve, and opens immediately the piston has entered the pipe. The main pipe is put together with deep socket joints, in each of which an annular space is left about the middle of the packing, and filled with a semi-fluid: thus any possible leakage of air into the pipe is prevented.

The following accounts of the working of this system on the Birmingham, Bristol, and Thames Junction Railroad, will prove its efficiency.

The part of the line on which the system is laid down is between the Great Western Railway and the Uxbridge road, on an incline, rising part 1 in 120 and part 1 in 115.

The section of vacuum pipe is half a mile long and nine inches internal diameter.

The exhausting pump is $37\frac{1}{2}$ inches diameter and $22\frac{1}{2}$ inches stroke, worked by an engine of sixteen horses power.

For the purpose of experiment, and to construct the annexed tables of the speed and load, a series of posts were

fixed along the half mile, every two chains apart, and a guage at each end of the pipe for the purpose of ascertaining the degree to which the pipe was exhausted. A vacuum equal to a column of mercury of 18 inches was obtained in one and a half or two minutes, and both guages indicated the same extent of vacuum at the same instant.

June 15, 1840.

At 4 h. 35 min.	A 50 10 20 28 35 41 48 54 60 5 10 15 20 25 30 35 40 44 49 53 B 20 10 8 7 6 6 5 5 5 5 5 5 5 5 5 4	22 $\frac{1}{2}$	36	26	2	24	8 2	$\begin{Bmatrix} 15 \\ 14 \\ 14 \\ 13 \end{Bmatrix}$
At 6 h. 5 min.	A 20 40 50 58 4 10 14 19 24 28 32 36 42 45 50 54 58 62 66 10 B 20 10 8 6 6 4 5 4 4 4 6 3 5 4 4 4 4 4	30	48 to 42	34-5 to 30-4	1	13	4 12	$\begin{Bmatrix} 16 \\ 16 \\ 15 \end{Bmatrix}$
At 6 h. 18 min.	A 22 45 57 6 14 22 29 36 42 48 54 60 6 10 14 20 26 30 35 40 B 23 12 9 8 8 7 7 6 6 6 6 4 4 6 6 4 5 5	22 $\frac{1}{2}$	36	26	2	9	7 2	$\begin{Bmatrix} 16\frac{1}{2} \\ 17 \\ 18 \\ 18\frac{1}{2} \end{Bmatrix}$

June 29, 1840.

At 3 h. 15 min.	A 50 55 60 65 10 15 20 24 29 33 37 40 B 5 5 5 5 5 4 5 4 4 3	30			2	28	8 2	
At 3 h. 30 min.	A 12 17 22 26 30 35 40 45 49 53 56 60 B 5 5 4 4 5 5 5 4 4 3 4	30			1	28	5 13	
At 3 h. 45 min.	A 10 14 18 23 27 31 35 38 41 43 $\frac{1}{2}$ 46 49 B 4 4 5 4 4 4 3 3 2 $\frac{1}{2}$ 2 $\frac{1}{2}$ 3	36			1	28	5 13	

July 24, 1840.

At 3 h. 52 min.	A 58 3 8 12 16 20 25 29 33 37 41 44 B 5 5 4 4 4 5 4 4 4 4 3	30			2	21	7 18	22
At 4 h. 12 min.	A 2 6 10 14 17 21 25 29 33 37 40 43 B 4 4 4 3 4 4 4 4 4 4 3 3	30			1	15	4 15	$\begin{Bmatrix} 22 \\ 21 \\ 20 \end{Bmatrix}$
At 4 h. 30 min.	A 31 35 39 42 46 50 54 58 2 5 8 11 B 4 4 3 4 4 4 4 4 4 3 3 3	30			1	8	4 6	$\begin{Bmatrix} 23 \\ 22 \\ 20 \\ 18 \end{Bmatrix}$

By following out these results, it will be found that a main pipe of eighteen inches diameter will be sufficiently large for a traffic of 5,000 tons per day, viz., 2,500 tons in each direction, supposing the gradients of the road to average 1 in 100.

Note. A main pipe, 18 inches diameter, will contain a piston of 254 inches area: the usual pressure on this piston, produced by exhausting the pipe, should be 8 lbs. per square inch (as this is the most economical degree of vacuum to work at, and a large margin is left for obtaining higher vacuums to draw trains heavier than usual on emergencies)—a tractive force of 2,032 pounds is thus obtained, which will draw a train weighing 45 tons, at 30 miles per hour up an incline rising 1 in 100. Two and a half miles of this pipe will contain 23,324 cubic feet of air $\frac{1}{30}$ ths of which, or 12,439 cubic feet, must be pumped out to effect a vacuum equal to 8 lbs. per square inch; the air pump for this purpose should be 5 ft. 7 in. diameter, or 24.7 feet area, and its piston should move through 220 feet per minute, thus discharging at the rate of $24.7 \times 220 = 5,434$ cubic feet per minute at first, and at the rate of 2,536 cubic feet per minute when the vacuum has advanced to 16 inches mercury, or 8 lbs. per square inch, the mean quantity discharged being thus 3,985 feet per minute: therefore $\frac{12439}{3985} = 3.1$ minutes, the time required to exhaust the pipe; and as the area of the pump piston is 14 times as great as that in the pipe, so the velocity of the latter will be 14 times as great as that of the former, or 220 feet per minute $\times 14 = 3,080$ feet per minute, or 35 miles per hour: but in consequence of the imperfect action of an air pump, slight leakages, &c., this velocity will be reduced to 30 miles per hour, and the time requisite to make the vacuum increased to 4 minutes: the train will thus move over the $2\frac{1}{2}$ miles section in 5 minutes, and it can be prepared for the next train in 4 minutes more, together 9 minutes; 15 minutes is therefore ample time to allow between each train, and supposing the working day to consist of 14 hours, 56 trains can be started in each direction or 2,520 tons, making a total of 5,000 tons per day. The fixed engine to perform this duty will be 110 horses power, equivalent to 22 horses power per mile in each direction.

WE will now compare the advantages and defects of the present system, and that which we propose.

1stly. The loss of power occasioned by the locomotive engines having to draw their own weight, is entirely avoided, and steep hills may be ascended with no more additional power than that actually due to the acclivity, as there is no weight except the train.

There is no other known power which can be applied to locomotion without carrying considerable weight and friction with it. The ill effects of locomotive engines have been already pointed out, and the same disadvantages exist in the application of ropes, which must be drawn along with the train, and become an increased incumbrance on inclined planes. The defects of ropes in other respects are too generally known to need comment.

2ndly. The weight of the rails and chairs on the new system may be less by two-thirds than where locomotive engines are employed, as the carriages of the train will be too light to injure them. The annual charge of maintenance of way will, from the same cause, be reduced to a considerable extent.

3rdly. The wear and tear of locomotive compared with stationary engines is as eighteen to one.

4thly. By the new system the full power of the engines is always obtained; and on an incline, the additional quantity of fuel consumed in ascending will be saved in descending, as the trains run down by their own gravity. The expense of fuel will be further decreased, as the cost of coal is only half that of coke.

On the new system the velocity depends entirely upon the velocity with which the air is withdrawn from the pipe; therefore, by simply increasing the air-pump, any speed may be attained; and with a fixed quantity of traffic per diem, no considerable increase in the fuel consumed, or any other expense, is incurred for improved speed, further than the small additional power occasioned by atmospheric resistance. An actual saving in the first cost of a railway constructed for high velocities may be effected, because, by performing the journey in less time, a greater number of trains may be despatched each day, and their weight diminished; therefore the piston having less to draw may be smaller in diameter. The cost of the pipe (which forms the largest item in the first cost of this railway) will thus be reduced in nearly the same proportion as the speed is increased.

Besides these advantages, this system possesses others of still more importance to the public. No collision between trains can take place, for as the power cannot be applied to more than one piston at a time in the same section of pipe, the trains must ever be the length of a section apart from each other; and if from any cause a train should be stopped in the middle of a section, the train which follows it will be obliged to stop also at the entrance of the pipe, as there will be no power to propel it until the first train is out. It is also impossible for two trains to run in opposite directions on the same line, as the power is only applied at one end of each section. A train cannot get off the rail, as the leading carriage is firmly attached

to the piston, which travels *in* the pipe *between* the rails; and the luggage and carriages cannot be burnt, as no engines travel with the trains.

We now come to the comparative cost of the two systems.

1st. The necessity of having the railway comparatively level causes the present enormous outlay for earth-work, viaducts and tunnelling: it also increases the cost of land, not only by lengthening the line to save cutting and embankment, but by the quantity wasted on each side of the road wherever an embankment or cutting is required. Thus if an embankment or cutting has to be made of thirty feet, at least sixty feet of land must be covered on each side of the railway in order to obtain sufficient slope, making a width of 120 feet, besides the road, except where they occur in stone or chalk. The comparative expense of this item between the two systems can be ascertained by referring to the average cost of forming a turnpike road and that of the principal railways now in operation.

LOCOMOTIVE SYSTEM.

	Per mile.
Taking five of the principal Railroads as the basis of our calculation, their average expense of for- mation has exceeded*	£36,000
And the original stock of Locomotives	1,600
Per mile . .	£37,600

ATMOSPHERIC SYSTEM.

The average expense of forming a turnpike road throughout England has been 3,000 per mile, but for our road, say	£4,000
Allow extra for road-bridges	2,000
Rails, chairs, sleepers, and laying down	2,500
Main pipe and apparatus complete (on a scale for transporting 360 tons per hour, or 5,000 tons per day of fourteen hours, on a road with gradients of 1 in 100)	5,200
Fixed engines, air pumps, and engine-houses	1,400
Travelling pistons	20
	£15,120
Saving per mile in forming and furnishing on the Atmospheric system	22,480
	£37,600

* Our calculations are founded on the reports of different companies whose railways are complete or in a forward state.

Annual expenses of working per mile, when conveying *two thousand tons* per day. (This is beyond the average quantity conveyed on the Liverpool and Manchester Railroad) :—

LOCOMOTIVE SYSTEM.

5 per cent. interest on capital sunk	£37,600	. . .	£1,880
Maintenance of way		. . .	450
Locomotive department, including coke		. . .	1,800
			£4,130

ATMOSPHERIC SYSTEM.

	Per mile.
5 per cent. interest on capital sunk, viz., £15,120 . . .	£756
Maintenance of way, and attendance on mains . . .	300
Wear and tear of fixed engines, 5 per cent. of cost . . .	70
Coal 0.75 lb. per ton per mile, 214 tons, at 20s. . .	214
Wages to engine men and stokers	60
Wages to train conductors	26
Renewal of travelling apparatus and composition, and sundries	200
	£1,626
Annual saving per mile on the Atmospheric system . . .	2,504
	£4,130

Total expenses per ton per mile on the Locomotive system 1.54 pence.

Ditto ditto ditto on the Atmospheric ditto 0.6 do.

Exclusive of carriages and management, which may be taken as the same on both systems.

A more striking example of the inefficiency of locomotive power cannot be given than that exhibited in the following Table, extracted from the last edition of Mr. Wood's Practical Treatise on Railroads.

Gross load in tons which a locomotive engine, capable of evaporating sixty cubic feet of water per hour, will drag, exclusive of the tender, at the under-mentioned rates of speed, on different inclinations of planes.

Inclination of plane.	10 miles an hour.	12 $\frac{1}{2}$ miles an hour.	15 miles an hour.	17 $\frac{1}{2}$ miles an hour.	20 miles an hour.	22 $\frac{1}{2}$ miles an hour.	25 miles an hour.	27 $\frac{1}{2}$ miles an hour.	30 miles an hour.
Level	Tons. 346	Tons. 251.10	Tons. 187.84	Tons. 142.64	Tons. 108.75	Tons. 82.38	Tons. 61.29	Tons. 44.04	Tons. 29.66
1 in 4480	325.72	236.09	176.35	133.66	101.65	76.75	56.83	40.54	26.95
1 in 2240	307.58	222.67	166.06	125.62	95.30	71.71	52.84	37.40	24.54
1 in 1120	276.47	199.65	148.44	111.85	84.41	63.07	45.99	32.03	20.39
1 in 1000	269.87	199.76	144.70	108.93	82.11	61.24	44.54	30.89	19.51
1 in 900	264.59	190.85	141.70	106.58	80.25	59.77	43.38	29.98	18.80
1 in 800	255.56	184.17	136.59	102.5	77.09	57.25	41.40	28.42	17.60
1 in 700	246.17	177.22	131.27	98.43	73.81	54.65	39.33	26.79	16.35
1 in 600	234.68	168.72	124.75	93.34	69.78	51.46	36.80	24.81	14.82
1 in 500	220.02	157.87	116.45	86.85	64.65	47.38	33.58	22.28	12.86
1 in 400	201.04	143.82	105.69	78.44	58.01	42.11	29.40	19	13.33
1 in 300	175.39	124.85	91.16	67.09	49.03	34.99	23.76	14.57	6.91
1 in 200	138.48	97.54	70.24	50.74	36.12	24.74	15.64	8.20	1.99
1 in 100	84.07	55.30	37.89	25.46	16.14	8.88	3.09	—	—

In the foregoing pages we have confined our remarks strictly to facts, in order to arrive at a conclusion that cannot be disputed.

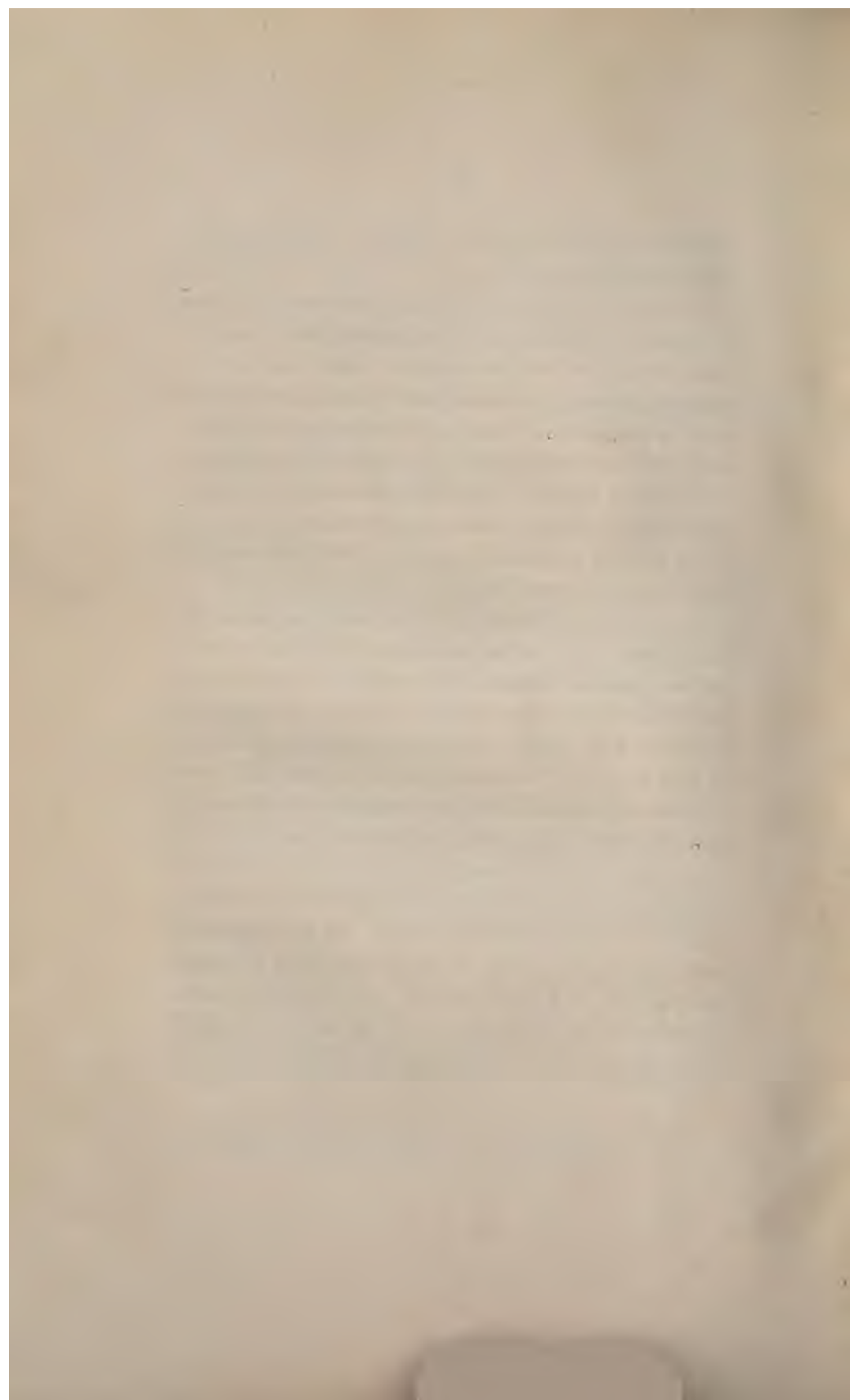
When Locomotive Railways were first introduced, it was not thought necessary or even possible to travel at a greater speed than eight to ten miles an hour:* from that period millions of capital have been expended, and

* See Mr. Stephenson's Evidence before the Committee of the House of Commons.

the first talent in the country employed to bring them to their present position.

We have no hesitation in asserting that we shall be able to improve the results that we have already shown, but the facts already elicited prove beyond doubt that by the general adoption of the atmospheric system the public will enjoy a cheaper and more secure conveyance than they could ever have obtained from Locomotive Railroads, and the capitalist a greater return for his money embarked. Advantages so obvious need only to be known to the public to be fully appreciated, and it is with that view that these pages have been written.

The efficacy and simplicity of the plan speak powerfully in its favour, and in its perfect operation is to be found the best possible refutation to any chimerical doubts as to its profitable application that may be started by those whose interest it is to prevent improvement and preserve things as they now are. That such persons do exist and have existed and combated every improvement with doubts and fears from time immemorial, unfortunately too many instances are within the knowledge of every one to allow us to think as we could wish—that this invention, on its introduction, will not meet with opposition ; but that opposition once surmounted, it will, by the natural course of events, become more firm in its position, and more perfect in its construction and application, until its adoption is absolutely necessary to the commercial interest of the nation.





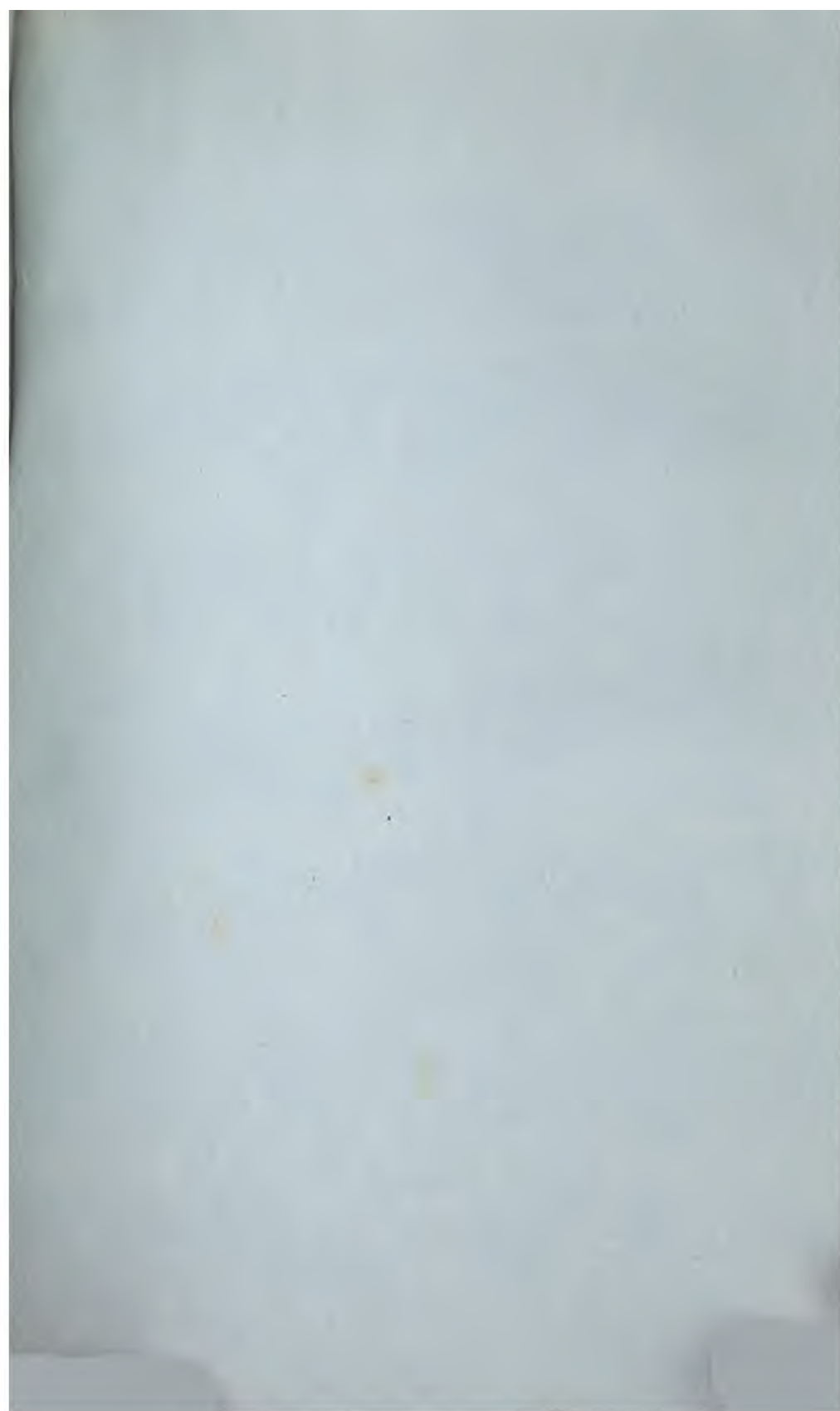






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